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Report to the Chairmen, Senate and House Committees on Armed Services

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MEDICAL ADP SYSTEMS

Changes in Composite Health Care System's Deployment Strategy Are Unwise

GAO/IMTEC-91-47

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The Honorable Sam Nunn
Chairman, Committee on Armed Services
United States Senate

The Honorable Les Aspin
Chairman, Committee on Armed Services
House of Representatives

The Composite Health Care System (CHCS) is a medical information system that the Department of Defense is developing for use in its more than 690 medical treatment facilities worldwide. The Congress has capped CHCS life-cycle costs at $1.6 billion. Defense is required by law to conduct an operational test and evaluation (OT&E) of CHCS, perform a cost/benefit analysis, and report the results to the armed services committees before awarding the full-deployment contract. This law also requires that GAO monitor OT&E and report to the committees within 30 days of Defense's report.

This report is one in a series dealing with Defense's acquisition, development, and testing of this system.[1] Our objectives were to (1) determine the status of CHCS' schedule, performance, cost, and benefits; and (2) identify and evaluate changes in Defense's development, testing, and deployment strategy. We conducted our evaluation from April 1990 through August 1991, in accordance with generally accepted government auditing standards. Appendix I details our objectives, scope, and methodology.

Results in Brief

CHCS shows promise of greatly enhancing Defense's ability to manage patient-care data, but Defense's recently revised strategy for testing and deploying the system is unwise. The strategy now provides for a deployment of CHCS with incomplete capabilities. Defense plans a March 1992 decision to deploy a software version that does not include, as originally planned, either the capability to arc' ive and retrieve patient records, or an efficient method for entry of physicians' orders. The capability to archive and retrieve patient data is vital to CHCS' operational performance and must be thoroughly tested and included in the software version upon which a deployment decision is made.

[1]See the Related GAO Products section at the end of this report.

Without archiving, system response time slows as the volume of data stored on-line reaches disk-capacity limits. At this point, with no way to offload data, additional disk storage and related equipment are required at additional cost. Defense has not yet produced any analysis estimating future cost growth or showing how such costs can be controlled without archiving.

Physicians' entry of inpatient orders is important to physician acceptance of the system. Since it is also crucial to realizing a significant purported dollar benefit, it is not yet clear that a version of CHCS that does not include physicians' entry of inpatient orders will be cost beneficial.

Even though significant operational testing issues remain unresolved and a credible determination of the system's costs and benefits is incomplete, Defense has expended or issued delivery orders totaling $12.9 million, as of July 1991, to deploy CHCS at 77 medical treatment facilities before the completion of operational testing. This deployment does not comply with Defense's own policy and, further, violates legislation.

Background

CHCS is a state-of-the-art, integrated medical-information system designed to improve the timeliness, availability, and quality of patient-care data. Currently, Defense estimates the life-cycle costs to total about $1.56 billion. CHCS will replace manual and automated information systems now supporting Defense medical treatment facilities. At individual hospitals, it will integrate the functional work centers of inpatient and outpatient care. These work functions include physicians' entry of orders, nursing, and dietetic instructions for inpatient care; and patient administration, patient appointment and scheduling, laboratory, pharmacy, and radiology data for both inpatient and outpatient medical care. CHCS provides a greater degree of patient data integration than is currently available in commercial hospital systems. The integrated patient record is intended to provide physicians with immediate access to all portions of a patient's medical record.

In March 1988, Defense awarded a contract to Science Applications International Corporation (SAIC) to develop, test, deploy, and support CHCS. Originally, OT&E for CHCS was scheduled for completion no later than September 1989. As of July 15, 1991, Defense had obligated about $444 million for development and deployment of the system. Currently, completion of OT&E is scheduled for March 1992. The project will then be

submitted to the Major Automated Information Systems Review Committee (MAISRC) for review and approval. Defense must then submit the results of OT&E and a cost-benefit analysis to the Congress.

CHCS Costs and Benefits Need Further Analysis

In March 1990, Defense's life-cycle cost estimate for CHCS was increased above the $1.1-billion ceiling established by the Congress. This increase was the result of a change in MAISRC guidance that defines life-cycle cost(s) and time frames. Subsequently, the Congress established a new $1.6-billion ceiling. As of May 1991, Defense's estimate of life-cycle costs was about $1.56 billion. However, since the current estimate does not include the impact of several components of CHCS, it is subject to change. These components include the costs to archive and retrieve patient data, and developing a more streamlined method for physicians' entry of orders.

CHCS benefits have yet to be quantified by a convincing analysis and documentation. In March 1990, Defense expected about 95 percent of the more than $2 billion in projected benefits to result from reducing the cost of the Civilian Health and Medical Program of the Uniformed Services (CHAMPUS). CHAMPUS pays health-care costs for active duty family members and retired uniformed services members and their dependents when they must receive medical services from private health-care providers. Defense assumed that CHCS would make medical care provided by the military more efficient and thus reduce the number of people seeking medical services from private health-care providers. In March 1990, we identified weaknesses in Defense's benefits study.[2] Since that report, Defense has changed the manner in which it portrays CHCS benefits. Currently, Defense is claiming that deploying CHCS will permit it to offset a portion of the expected growth in future health-care costs.

Defense's analysis shows that health-care costs between 1985 and 1990 increased at an average rate of 8.4 percent per year. Defense, however, is now budgeting for later-year health-care cost increases of only 4.4 percent per year. It justified this lower figure by claiming that CHCS will help avoid the costs that make up the difference through better operating efficiencies at its medical treatment facilities. Defense plans to provide evidence to support claims of cost avoidance based on the results of operational testing and evaluation, which are currently scheduled for completion next March.

[2]Medical ADP Systems: Composite Health Care System: Defense Faces a Difficult Task (GAO/IMTEC-90-42, Mar. 15, 1990).

Defense Now Plans to Deploy CHCS Without Essential Capabilities

In March 1990, we reported that Defense had extended OT&E to October 1990 because of software-development delays.[3] At that time, Defense planned to operationally test and evaluate a fully integrated CHCS at Fort Knox and 6 of its 12 test sites before making a deployment decision. (A list of test sites is shown in appendix II.) The fully integrated system was to include such activities as patient appointment and scheduling, physicians' order entry, laboratory, radiology, pharmacy, and nursing. This schedule, however, was not met.

As a result, Defense extended the completion date for OT&E to March 1992. But much more importantly, it has now changed the strategy for fielding CHCS. Instead of making a decision at the completion of OT&E to field a fully integrated CHCS worldwide, Defense is now planning to deploy CHCS without essential capabilities. According to Defense, this decision will be made following a full OT&E of the capabilities to be fielded, a user-community certification that the version of CHCS to be deployed is useful, and completion of a supporting cost-benefit analysis. The decision will receive MAISRC review.

The deployment decision planned for March 1992 will be based on a version of CHCS software that does not include two important capabilities: the ability to archive and retrieve patient records, and a streamlined method for physicians' entry of patient orders. Because of difficulty in designing and testing these capabilities, they have been deferred and will be included in later reviews and fieldings of CHCS.

Archiving—Archiving is the ability to store off-line and later retrieve patient data. It is essential to effective CHCS operations and is still under development. Deploying CHCS without assurances that the archiving capability can be effectively and economically incorporated into the system could ultimately result in serious operational problems and increased costs. Currently, Defense does not have any plans to test this capability at any CHCS OT&E site until after the March 1992 deployment decision. There will, however, be some testing of archiving and retrieval in the contractor's laboratory.

The effort involved in designing and implementing an effective archiving capability in CHCS is complex. It is technically challenging, in part, because CHCS software is highly integrated, relationships among patient information are complex, and a nontraditional file structure is used. The extraction of patient information from this file structure must

[3]GAO/IMTEC-90-42, Mar. 15, 1990

be performed in a flawless manner to ensure that relationships between all segments of the active data are preserved and the archived data can later be reassembled when needed for patient care or medical research. Before such a complex and important capability is deployed, it is essential that it be thoroughly tested in a representative set of hospital environments.

Operating CHCS without archiving is impractical. Without archiving, system response time slows as the volume of data stored on-line reaches disk-capacity limits. Efforts to improve the response time can be time-consuming and disruptive, and eventually ineffective, as even more data are stored on disk. At this point, with no way to offload data, additional disk storage and related equipment (controllers and faster processors with more input/output channels) are required. As patients continue to be treated, the need for hardware will continue to grow. The costs of such growing hardware configurations, however, have not been carefully analyzed by Defense. For example, Tripler Army Medical Center has already replaced its disk drives with higher-density models and added more storage units. Defense has not yet produced any analysis estimating future cost growth or showing how such costs can be controlled without archiving.

Defense plans to provide an archiving capability in the future. However, given that archiving is technically challenging and is already behind schedule, and that software projects are often delivered significantly behind schedule, it is not judicious to deploy CHCS hoping that its open ended cost growth will be controlled by a capability promised in the future.

Physicians' orders—Hospital personnel who use CHCS are pleased with the system's performance in some areas—primarily outpatient care functions. However, other parts of the system, especially the process by which physicians enter inpatient orders, are unacceptable to many doctors. This unacceptability is primarily due to the way physicians have to enter both conditional or complex orders. For example, treatment of a single patient can require a physician to enter data through the keyboard to bring up as many as 10 different screens. This lack of acceptance was evident as early as the spring of 1990 when this capability was deployed to the test sites. Since then, even with improvements, only 5 of 12 CHCS test sites have activated the order entry functionality. Although Defense has implemented shortcuts that significantly reduce the time it takes to input some physician orders, much remains to be done to streamline this process. SAIC and Defense are aware of these problems.

They are working toward a solution that is commonly known as one-line-order-entry (OLOE). Defense is attempting to obtain additional funding to expedite the development and testing of OLOE.

OLOE will not be fully developed and tested as part of the current OT&E. This capability is critical to the system's inpatient functionality and physician acceptance of the full system. It directly provides about 10 percent of the system's total benefits according to Defense estimates. Therefore, it is unclear whether CHCS will be cost beneficial without OLOE.

Premature Deployment of CHCS Violates Defense Directives and Legislation

Defense is required to conduct an OT&E of all major automated information systems. OT&E of an automated system is a field test and evaluation of the system under realistic conditions. The primary purpose of OT&E is to ensure that only operationally effective and suitable systems are delivered to the ultimate users in the field.

Defense's policy requires a structured process for MAISRC review of information on systems at six milestones during their life cycles.[4] (A description of these milestones is included in appendix III.) CHCS is nearing milestone III, the deployment phase. OT&E provides MAISRC with objective data on system performance and effectiveness, and as such is a critical input in deciding whether the system should be deployed.

In recent years significant cost increases in Defense information systems acquisitions—along with schedule delays, performance shortfalls, redirected development and acquisition strategies, and noncompliance with regulations—have led the Congress to question Defense's ability to manage these acquisitions effectively.[5] More specifically, the Congress has questioned whether funds are being obligated for systems that have not successfully completed required oversight reviews. To preclude this problem, the Congress inserted the following requirement in each Defense appropriations act since fiscal year 1987:

> None of the funds appropriated or made available by this Act may be obligated for acquisition of major automated information systems which have not successfully completed oversight reviews required by Defense Department Regulations.

[4]Life-Cycle Management of Automated Information Systems (AIS), Defense Directive 7920.1, and accompanying Defense Instruction 7920.2.

[5]DOD Automated Information Systems Experience Runaway Costs and Years of Schedule Delays While Providing Little Capability, Report of the House Committee on Government Operations,(HR 101-382, Nov. 20, 1989).

In June 1988, the Office of the Secretary of Defense reemphasized the statutory language to require that the head of each Defense component

> ensure that no funds are obligated for the acquisition of an [automated information system] that has not successfully completed an appropriate management review and obtained milestone approval required by this [directive and the accompanying Defense Instruction 7920.2].

Even though Defense has not completed OT&E and MAISRC has not approved CHCS' deployment, Defense expended funds to deploy CHCS beyond its test sites. These deployments violate the preceding Defense directives and statutory restrictions. As of July 1991, Defense had expended or issued delivery orders totaling $12.9 million to deploy CHCS at 77 medical treatment facilities beyond the 12 test site hospitals. Defense has already allowed the Air Force to deploy a version of CHCS software to 58 medical facilities—27 hospitals and 31 clinics. Deployment was completed in April 1991 and cost the Air Force about $5.4 million. Defense has also expended or issued delivery orders totaling $7.5 million to begin deploying CHCS at another 19 military hospitals where it says existing systems are unreliable and experiencing frequent and lengthy episodes of hardware down time. Thus, even before CHCS has completed OT&E, Defense will have initiated or completed installation of a version of CHCS at 58 hospitals, more than one-third of the 155 hospitals targeted for CHCS.

Conclusions

CHCS shows promise of enhancing the quality and availability of Defense patient care data, but Defense's revised strategy for deploying the system without essential capabilities is unwise. Deploying CHCS without archiving is impractical because this function is critical to the system's operational performance and the establishment of a credible cost estimate. We do not believe any deployment decision should be made without an archiving function. Regarding physicians' entry of orders, it is unclear that deploying CHCS without it will be cost beneficial.

Because of the significant financial investment needed to bring CHCS into full operation, it is vital that there be an OT&E of the full system before it is deployed. Defense's deployment of CHCS at some 77 medical treatment facilities that are not test sites is premature and violates existing legislation and Defense directives.

Recommendations

We recommend that the Secretary of Defense direct the Assistant Secretary of Defense for Health Affairs and the military departments to refrain from

- deploying CHCS without the capability to archive and retrieve patient data, and
- further deployment of CHCS until completion of OT&E and the performance of a cost-benefit analysis that justifies such a deployment.

Agency Comments and Our Evaluation

In commenting on a draft of this report, the Department of Defense disagreed with some of our findings and one of our recommendations. Specifically, Defense does not agree with our finding and recommendation that CHCS should not be deployed without the capability to archive and retrieve patient records. It also believes that the report does not adequately recognize the incremental strategy for deploying CHCS. Defense states that while it appreciates the work we have done, it has the responsibility to determine the required functional capabilities for each increment of deployment. Finally, Defense disagrees with our finding that deployments beyond the designated test sites were in violation of Defense directives and statutory restrictions.

Although Defense does not agree with our recommendation that CHCS should not be deployed without the capability to archive and retrieve patient data, it admits that this capability is essential to system operations. Defense also believes that there is low risk in deploying CHCS without the capability to archive and retrieve. We do not agree with this assessment. For example, during our review of existing CHCS test sites, we found that the lack of archiving was contributing to operational instability (fluctuations in system response times because of the volume of data stored on-line) and increasing costs (additional storage had to be purchased because existing capacity had been exhausted).

The Defense directive on test and evaluation states that the primary purpose of OT&E is to ensure that only operationally effective and suitable systems are delivered. The directive further states that the testing shall be accomplished in an environment that is as operationally realistic as possible. By not testing this capability in a realistic environment before the first milestone III decision is made, Defense is incurring significant risk by acquiring a system that may not meet operational needs and may not be cost-effective. We continue to believe that the archive and retrieve capability should be included in the first milestone III deployment decision, not only because it is essential to the system's

operation, but because it is also essential to Defense's ability to determine and control the cost of CHCS deployment and operations.

Further, it is important to note that, although Defense contends that it is making an incremental deployment of CHCS, the decision to deploy the first increment will require installation of nearly all the operational hardware and software ultimately needed. This includes full physical and electrical site preparation; installation of central processing units, disk drives, and terminals for all hospital operating units; communication systems; full CHCS software packages; and user training. Subsequent incremental deployments will consist primarily of software upgrades, more and higher density disks, and other auxiliary equipment.

While it is true that Defense is responsible for determining the required functional capabilities for each increment of CHCS deployment, the law requires that we evaluate this program and inform the Congress of any significant risks that Defense is taking relative to CHCS. In our opinion, deploying CHCS without the archiving and retrieval capability is a significant cost and operational risk.

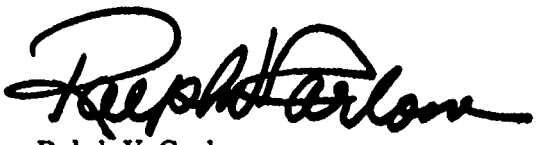
Defense believes that all CHCS deployments have been in compliance with legislation and Defense policy. The law, however, expressly precludes the obligation of appropriated or otherwise available funds for the acquisition of major automated information systems that have not successfully completed oversight reviews, as required by Defense Department Regulations. Milestone reviews are the only reviews required by Defense. In June 1988, the Office of the Secretary of Defense reemphasized that statutory language's connection with milestone reviews by requiring Defense components to obtain milestone approval before making further expenditures.

Defense further states that a MAISRC in-process review on May 21, 1991, endorsed the incremental deployment of CHCS. The deployments of CHCS to the 58 Air Force facilities and 19 military hospitals not included as test sites, however, are not related to the incremental deployment strategy established by Defense at that MAISRC review. The $12.9 million expenditure by Defense to deploy CHCS to these facilities occurred prior to the May MAISRC review. Therefore, we continue to believe that these deployments were in violation of Defense directives and legislation.

Detailed Department of Defense comments and our evaluation are contained in appendix IV.

We are sending copies of this report to the Chairmen of the House and Senate Committees on Appropriations; the Director, Office of Management and Budget; and the Secretary of Defense. Copies also will be made available to other interested parties upon request.

This work was performed under the direction of Frank W. Reilly, Director, Human Resources Information Systems, who can be reached at (202) 275-4659. Other major contributors are listed in appendix V.



Ralph V. Carlone
Assistant Comptroller General

Contents

Abbreviations

CHAMPUS	Civilian Health and Medical Program of the Uniformed Services
CHCS	Composite Health Care System
DOD	Department of Defense
GAO	General Accounting Office
IMTEC	Information Management and Technology Division
IRM	Information Resources Management
MAISRC	Major Automated Information Systems Review Committee
OLOE	One-Line-Order-Entry
OT&E	Operational Test and Evaluation
SAIC	Science Applications International Corporation

Objectives, Scope, and Methodology

The National Defense Authorization Act for Fiscal Year 1987, as amended, requires that GAO (1) monitor the operational test and evaluation (OT&E) phase and related CHCS acquisition activities, and (2) submit a report to the Senate and House Committees on Armed Services that evaluates OT&E results and Defense's contract award process for CHCS' full production, and determines whether Defense conducted OT&E at a sufficient number of sites with sufficient software in operation to warrant a full-deployment decision. The act requires that our final report on OT&E for CHCS be issued 30 days after the Senate and House Committees on Armed Services receive Defense's report on the OT&E results.

Our objectives were to (1) assess the status of CHCS' cost, schedule, and performance; and (2) identify and evaluate changes in Defense's development, testing, and deployment strategy. In conducting our review, we examined Defense's 13 detailed test and analysis plans for OT&E; reviewed Defense's most current (May 1991) CHCS System Decision Paper and supporting documentation; evaluated the monthly progress reports provided to Defense by the CHCS contractor through August 1991; and tracked all delivery orders, including modifications to the delivery orders, which Defense issued against the CHCS contract through August 22, 1991.

We viewed the operation of CHCS at 5 of the 12 operational test sites: Ft. Knox, Kentucky; Eglin Air Force Base, Florida; Naval Hospital, Jacksonville, Florida; Naval Hospital, Charleston, South Carolina; and Tripler Army Medical Center, Hawaii. Fort Knox and Tripler serve as alpha test sites where initial testing for new CHCS software is conducted. We also met with SAIC officials in La Jolla, California (the prime contractor), and the Defense Medical Systems Support Center in Falls Church, Virginia (the program office managing the CHCS acquisition).

In addition, we met with Defense and contractor officials at Malcolm Grow Medical Center at Andrews Air Force Base, Maryland, which is an operational test site for the deployment of limited CHCS to an additional 17 military medical treatment facilities beyond the OT&E sites. We obtained information on the condition of the existing automated systems from representatives at Malcolm Grow and 10 other military hospitals.

We worked closely with senior program management officials to (1) discuss our concerns as they arose, (2) confirm our understanding of potential problems and their implications for the achievement of test objectives, and (3) permit the officials to respond to our observations.

We conducted our evaluation from April 1990 to August 1991 in accordance with generally accepted government auditing standards. We briefed senior program management officials during our review and incorporated their views where appropriate.

CHCS Test Sites as of August 1991

Test sites	Hospital beds
Ireland Army Hospital Fort Knox, Kentucky	184
Tripler Army Medical Center Honolulu, Hawaii	479
Naval Hospital Charleston, South Carolina	184
United States Air Force Hospital Eglin Air Force Base Valpariso, Florida	145
Naval Hospital Jacksonville, Florida	178
98th General Army Hospital Nuernberg, Germany	142
United States Air Force Regional Hospital Sheppard Air Force Base Wichita Falls, Texas	135
363rd Medical Group Shaw Air Force Base Sumter, South Carolina	40
Eisenhower Army Medical Center Fort Gordon, Georgia	384
United States Air Force Medical Center Keesler Air Force Base Biloxi, Mississippi	295
Walter Reed Army Medical Center Washington, D.C.	886
Naval Hospital Camp LeJeune Jacksonville, North Carolina	170

Life-Cycle Management Milestones

Milestone 0: The purpose of milestone 0 is to determine whether to proceed to the concepts-development phase on the merit of the definition and justification of a mission need. A mission-need statement is approved at milestone 0, and the Defense component is authorized to initiate the concepts-development phase and to expend resources for the activities of that phase, as planned.

Milestone I: The purpose of milestone I is to select the best program after evaluating functional and technical alternatives that satisfy the approved mission-need statement. The best program is the one that satisfies the mission need at the lowest total life-cycle cost. The milestone I approval authorizes program management to initiate the design phase and to expend resources for the activities of that phase, as planned.

Milestone II: The purpose of milestone II is to validate the adequacy of the selected automated information system design on the basis of completed, detailed specifications. Milestone II approval authorizes program management to initiate the development phase and to expend resources for the activities of that phase, as planned. Milestone II approval may include authorization to test and evaluate prototype capabilities at a set number of operational installations.

Milestone III: The purpose of milestone III is to determine whether the completed, comprehensively tested, and operationally capable automated information system satisfies the mission need and is ready for deployment. Milestone III approval authorizes program management to begin deployment and expend resources for that phase, as planned; to begin systems operations at each systems site upon completion of deployment at that site; and to transfer systems management responsibility from the program manager to the post-development manager, in accordance with approved plans. The milestone III decision memorandum identifies the milestone IV approval authority for the automated information system.

Milestone IV: The purpose of milestone IV is to assess post-deployment automated information systems operations and to approve plans for short-term, post-deployment systems modernization. Milestone IV occurs no later than 1 year after the completion of systems deployment. Automated information systems post-deployment management submits a systems decision paper for review by the milestone IV approval authority. Milestone IV approval validates that the mission need is being satisfied; operation support of the system is acceptable; and systems affordability, performance, and benefits are within acceptable limits. It

also authorizes post-deployment management to expend resources for approved, short-term, post-deployment systems modernization.

Milestone V: The purpose of milestone V is to determine if the existing automated information system continues to satisfy revalidated mission needs, requires modernization, or should be terminated. Milestone V shall occur at a point halfway through the operational life of the system, or not later than 4 years after milestone IV, whichever occurs first. Milestone V approval authorizes post-deployment management to program resources for long-term systems modernization or replacement and for initiation of the concepts-development phase. A fully updated and revalidated mission-needs statement is required for milestone V approval.

Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

OFFICE OF THE SECRETARY OF DEFENSE

WASHINGTON, D.C. 20301

22 AUG 1991

Mr. Ralph V. Carlone
Assistant Comptroller General
Information management and
Technology Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Carlone:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) Draft Report, entitled "MEDICAL ADP SYSTEMS: Changes in Composite Health Care System's Deployment Strategy Are Unwise," dated August 9, 1991 (GAO Code 510559), OSD Case 8780. The Department agrees with the GAO's observation that the Composite Health Care System shows promise of greatly enhancing the ability of the Department of Defense to manage patient care data; however, the Department disagrees with some of the report findings and one of the recommendations.

The GAO report does not recognize adequately the DoD incremental deployment strategy for the Composite Health Care System, as endorsed by the Major Automated Information System Review Council. The System Decision Memorandum documenting the May 21, 1991 In-Process Review reflects that strategy. The Department's actions are in compliance with legislation, are consistent with the DoD policies for life-cycle management of automated information systems, and will continue to be in compliance with legislation.

The DoD appreciates the work GAO has done in reviewing the Composite Health Care System and has acted positively upon many of the suggestions, thereby strengthening the program. It is, however, the Department's responsibility to determine the required functional capabilities for each increment. Such decision making is necessary to meet critical information system needs and to begin recouping the benefits of proven system capabilities as soon as possible. Deployment decisions will not be made before appropriate cost, benefit, performance, and risk data have been reviewed. The detailed DoD comments on the report findings and recommendations are provided in the enclosure.

Thank you for the opportunity to provide comments on this report.

Sincerely,

Enrique Mendez, Jr., M.D.
Assistant Secretary of Defense
(Health Affairs)

Duane P. Andrews
Assistant Secretary of Defense
(Command, Control, Communications and Intelligence)

Enclosure:
As Stated

GAO DRAFT REPORT - GAO/IMTEC-91-47 - DATED AUGUST 1991
(GAO CODE 510559) OSD CASE 8780

"MEDICAL ADP SYSTEMS: CHANGES IN COMPOSITE HEALTH CARE SYSTEM'S DEPLOYMENT STRATEGY ARE UNWISE"

DEPARTMENT OF DEFENSE COMMENTS

* * * * *

FINDINGS

FINDING A: Status Of The Composite Health Care System. The General Accounting Office reported that the Composite Health Care System is a state-of-the-art, integrated medical information system designed to improve the timeliness, availability, and quality of patient care data. According to the GAO, the DoD currently estimates the life-cycle costs to total about $1.56 billion. The GAO found that operational test and evaluation, originally scheduled for completion by September 1989, is currently scheduled for March 1992. The GAO reported that as of July 15, 1991, the DoD had obligated about $414 million for development and deployment of the system. (pp. 1-2/GAO Draft Report)

DoD Response: Concur. A point of clarification is, however, indicated. The Composite Health Care System is to be deployed in increments. By March 1992, operational test and evaluation for the first increment of software will be complete. Additional operational test and evaluation will be conducted on subsequent increments prior to their deployment.

FINDING B: The Composite Health Care System Costs and Benefits Need Further Analysis. The GAO reported that, in March 1990, the DoD life cycle cost estimate for the Composite Health Care System exceeded the $1.1 billion ceiling established by the Congress. According to the GAO, the Congress subsequently established a new ceiling of $1.6 billion for the System. The GAO noted that the current DoD life-cycle cost estimate for the System is about $1.56 billion. The GAO observed that the estimate is subject to change, since the current estimate does not include the costs to (1) archive and retrieve patient data, (2) configure hardware at sites where capacity requirements are uncertain, (3) correct known problems with system software, and (4) develop a more streamlined method for physician's entry of orders. Also, the GAO found that the system benefits have yet to be quantified by a convincing analysis and documentation.

The GAO referenced a March 1990 GAO report (OSD Case 8277-A), in which it reported on weaknesses in the DoD benefits study. The GAO found that, since that report, the DoD has changed the manner in which it portrays Composite Health Care System benefits. According to the GAO, the DoD claims that deploying the System

will permit it to offset a portion of the expected growth in future health care costs. The GAO also observed that the DoD analysis shows health care costs increasing at an average rate of 8.4 percent per year between 1985 and 1990; yet, the DoD has only budgeted for a 4.4 percent per year health care cost increase. The GAO reported that the DoD contends deploying the Composite Health Care System will permit it to offset a portion of the expected growth in future health care costs. (pp. 4-5/GAO Draft Report)

See comment 1.

DoD Response: Partially concur. Cost and benefit analysis is a continuous process throughout the life-cycle of a program and updates are required for each milestone review. Program life-cycle cost estimates, including those cited by the GAO, are under review by the Office of Assistant Secretary of Defense (Program Analysis and Evaluation) and will be validated prior to the Milestone III review. The Composite Health Care System cost estimate was verified independently, in accordance with DoD regulations, at Milestone II and will continue to be validated throughout the life cycle of the project. The cost data for the System estimates are based on experience at the test sites. As with any model, refinements will be made as more experience is acquired.

System benefits have been quantified in a benefits model that is also being evaluated by Program Analysis and Evaluation for Milestone III. Most of the benefit factors are based upon validated benefits from independent operating capabilities in support of laboratory, appointment and scheduling, radiology, and pharmacy, implemented by the DoD in preparation for the Composite Health Care System. The benefits are also based on experience at sites with early hospital information systems. The model will continue to be updated as new benefits are identified.

In addition to the traditional benefits analysis for the March 1992 Milestone III review, a business case analysis will be presented that addresses the health care delivery and management processes supported by the System. It is expected that analysis will show the extent to which benefits of the Composite Health Care System come from implementing new business practices and improved ways of delivering care in DoD facilities, which are made possible by the System. The DoD has only budgeted for 4.4 percent per year health care cost increases because deploying the Composite Health Care System will permit it to offset a portion of the expected growth in future health care costs.

A further point of clarification is that, as noted in the Department of Defense response to the March 1990 GAO report, the increase in the ceiling from $1.1 billion to $1.6 billion was requested by DoD to reflect the change in the Major Automated Information System Review Council guidance that defines life-cycle costs and time frames.

FINDING C: The DoD Plans To Deploy the Composite Health Care System Without Essential Capabilities. The GAO pointed out that in its March 1990 report (OSD Case 8277-A), it reported that the DoD extended Operational Test and Evaluation to October 1990, because of software development delays, and planned to operationally test and evaluate a fully integrated system at Fort Knox and at six of its 12 test sites before making a deployment decision. The GAO found, however, that because the schedule was not met, the DoD extended the operational test and evaluation completion date to March 1992 and changed the strategy for fielding the system.

The GAO observed that the DoD now plans to deploy the system without essential capabilities, such as (1) the ability to archive and retrieve patient records and (2) a streamlined method for physician entry of patient orders, because of design and testing difficulties. According to the GAO, the deployment decision planned for March 1992 will be based on a version of software that does not include those capabilities and could result in serious operational and financial problems in the future. The GAO concluded that operating the Composite Health Care System without archiving is impractical. The GAO observed that archiving is complex and technically challenging and should be thoroughly tested in a representative set of hospital environments before deployment. The GAO further concluded that without the physician one-line-order entry capability, which will not be fully tested as part of the current operational test and evaluation, the Composite Health Care System cost benefits are unclear. (pp. 5-9, p. 11/GAO Draft Report)

See comment 2.

DoD Response: Nonconcur. Since the GAO March 1990 report, the DoD changed the strategy for fielding the Composite Health Care System. The deployment strategy is reflected in the System Decision Memorandum dated June 13, 1991, documenting the May 21, 1991 Council In-Process Review of the System. A copy of the System Decision Memorandum previously was provided to the GAO. The revised strategy, which is strongly supported by the Council, the Assistant Secretary of Defense (Health Affairs), and the Military Department Surgeons General, entails the incremental deployment of Composite Health Care System functionality, which is needed to meet mission requirements and is ready for Council review. Each increment will be tested fully in an operational test and evaluation environment. The results will be presented to the Operational Test and Evaluation Review Group and then reviewed by the Office of the Secretary of Defense (Director, Operational Test and Evaluation). Those increments containing significant additional capabilities will be forwarded for Council review prior to deployment beyond test sites.

Archiving and retrieving of patient records is essential to System operations and will be tested thoroughly. In fact, development of the archive and retrieve capability has been completed and testing has already begun. Approximately seven

months of comprehensive testing of the archive/retrieve capability will occur, as well as an independent Early Operational Assessment, with the results submitted to the Major Automated Information System Review Council prior to the first Milestone III review. There will be sufficient evidence obtained through testing to ensure that the archiving capability will be incorporated effectively and economically into the system. Finally, risk appears to be low because experience has shown saturation is not reached until 18-24 months after activation. Based upon the post Milestone III deployment plan, the earliest that saturation would be reached is March 1994 and archive/ retrieve capability will be available for full deployment by early calendar year 1993. Any deployment decision will occur after a complete operational test and evaluation and include consideration of the risks, costs and schedules for fielding this capability.

See comment 3.

The Department is actively pursuing completion of the one-line-order-entry. Full inpatient order entry presently is operating at Ireland Army Community Hospital, Fort Knox, Kentucky and Tripler Army Medical Center, Honolulu, Hawaii and partial inpatient order entry is running at the beta test sites. Three initiatives are in process to support the effort. 1) Additional on-site program resources have been dedicated to Tripler and Fort Knox to enhance the process of understanding the necessary design changes and improvements as recommended by the "Report - National Defense Authorization Act for Fiscal Years 1992-1993 on H.R. 2100." 2) The professional clinical user community is leading the redesign effort. Approximately 40 experienced health care professionals from all three Services' military medical treatment facilities met in July 1991 to discuss and document the necessary changes. 3) The Office of the Assistant Secretary of Defense (Health Affairs) has requested $3 million from the Corporate Information Management Program for acceleration of one-line-order-entry implementation.

The report states that early operational test and evaluation found that, in some instances, Composite Health Care System physician inpatient order entry took from 25 to 40 minutes longer than handwriting orders. It is inappropriate to compare the time for a physician to write an order with the time required to enter that order on the computer via the System order entry module. In the Composite Health Care System, at the completion of the order entry process, the order is checked, validated, and transmitted to the appropriate department. In the manual process, the handwritten order still has to be transcribed to other forms (e.g., laboratory transmittal slips, nursing due lists, etc.), or read and interpreted by other health care providers (e.g., pharmacists and nurses). Additionally, the order has to be hand-carried or telephonically transmitted from the point of origin to its final destination. For fair comparison, the total time for the manual process and the comparable Composite Health Care System process must be considered.

In early 1991, an actual comparison was conducted between Tripler Army Medical Center, Honolulu, and the National Naval Medical Center, Bethesda. The time required to process a standard 13 order set at Tripler Army Medical Center, using the Composite Health Care System was compared to the time required to process the same orders at Bethesda using handwritten orders. It took less than 2.5 minutes to enter and process this standard order set using the Composite Health Care System at Tripler. The time required to manually process these same orders was shown to vary from 7 to 17 minutes at Bethesda. Thus, not only is the time required to enter admissions orders shorter than the 30-45 minutes cited in the GAO report, but in addition, they are fully validated and transmitted as part of inpatient order entry. The majority of inpatient orders are processed more effectively using the Composite Health Care System. The small subset of complex inpatient orders, e.g., intensive care unit orders, that do require more physician time are being addressed and, as discussed above, efforts are underway to streamline the processing.

See comment 4.

The GAO concluded that it is unclear whether the Composite Health Care System will be cost beneficial without one-line-order-entry in the first increment. It is due to the critical need of certain Composite Health Care System functions required to offset growing cost and health care delivery and management problems that the decision was made to incrementally develop and deploy the Composite Health Care System. While one-line-order-entry may account for a small percentage of the System benefits, the majority of the benefits will be achieved by functionality contained in the first increment, as implemented at the medical treatment facilities. These functions, which include integrated ancillary support to the areas of patient administration, patient appointing and scheduling, pharmacy, laboratory, and radiology, along with flexible level of results reporting capability for direct health care professionals, are immediate requirements. The decision to deploy the Composite Health Care System incrementally is a low risk pathway, driven by the recognition that medical treatment facilities desperately need this Composite Health Care System functionality. Many are without these essential functions or have costly, undersized and aging automated systems that require immediate replacement.

In addition to these cited benefits, the advantages derived from deployment of the majority of the Composite Health Care System after a March 1992 review include: the elimination of duplicate data entry; military health services system-wide utilization of standard data elements and codes; the installation of standard hardware architecture which can easily grow to accommodate increases in both workload and functionality; and more time to properly address the complex issues surrounding one-line-order-entry. The modular deployment philosophy of the System does not detract from, but complements the capability to deploy fully, since the full Composite Health Care System builds on an integrated patient data base, which is installed with the first increment of software.

FINDING D: Premature Deployment of the Composite Health Care System Violates Defense Directives and Legislation. The GAO reported that the DoD is required to conduct an operational test and evaluation of all major automated information systems to ensure their suitability and effectiveness under realistic conditions. The GAO explained that DoD policy requires a structured process for the Major Automated Information System Review Council to review information on systems at six milestones during their life cycles. The GAO noted that the Composite Health Care System is nearing a Milestone III deployment decision, and that operational testing and evaluation provides data critical to the Review Council deployment decision. The GAO reported, however, that recent significant cost increases in DoD information systems acquisitions have led the Congress to question (1) the DoD ability to manage the acquisitions effectively and (2) whether funds are being obligated for systems that have not completed the required oversight review successfully. The GAO explained that, to preclude the problem, the Congress has inserted language in each DoD appropriations bill since FY 1987, and stated that funds are not to be obligated for major automated information systems acquisitions that have not completed successfully the oversight reviews required by DoD regulations. The GAO observed that, in June 1988, the Office of the Secretary of Defense reemphasized the statutory language and required component heads to ensure that no funds are obligated for an automated information system if it has not completed an appropriate management review successfully and obtained milestone approval required by DoD Directives.

The GAO found that, although Composite Health Care System operational test and evaluation has not been completed and the Major Automated Information Systems Review Council has not approved system deployment, the DoD has expended funds to deploy the System beyond its test sites. The GAO pointed out that the DoD issued purchase orders totaling $13.2 million to deploy the System at 76 medical treatment facilities and an additional $7.8 million to begin deploying the System at another 18 military hospitals experiencing problems with their existing systems. The GAO concluded that those deployments violate DoD Directives and statutory restrictions. The GAO explained that before the System has completed operational test and evaluation, the DoD will have initiated or completed installation of a version of the system at 57 hospitals--more than one-third of the 155 hospitals targeted to receive the system. The GAO also concluded that an operational test and evaluation of the full system is vital before it is deployed. (pp. 9-12/GAO Draft Report)

See comment 5.

DoD Response: Nonconcur. The Department of Defense is in full compliance with applicable Defense guidance and legislation. The Major Automated Information System Review Council reviews are being held, as required. Attachment III to the GAO report quoted Defense Instruction 7920.2, in which the GAO noted that at the milestone reviews required during the life cycle of a system

"represent the minimum set of decision points requiring direct senior management involvement in an automated information system program." The applicable statute does not require, nor has it been DoD policy, that oversight reviews be limited only to milestone reviews. Senior management involvement and decisions are also made at times other than Milestone reviews. For example, the 21 May 1991 Review Council In-Process Review endorsed the incremental deployment of the Composite Health Care System. The System is receiving, and will continue to receive, considerable more than the minimum Review Council oversight.

See comment 6.

Deployments to date are consistent with Review Council authorization and existing legislation. Applicable DoD regulations specifically provide for conditional approvals. The Composite Health Care System program office has not deployed any software without having explicit authority to do so from the appropriate DoD Information Resources Management official. In addition to the 12 operational test and evaluation sites, software was deployed to Malcolm Grow Medical Center at Andrews Air Force Base, for certification testing of the Patient Appointing and Scheduling module in compliance with congressional direction. Prior to legislation limiting the deployment of the Composite Health Care System, a sound business decision was made to deploy the Standard Appointment and Scheduling System to 58 Air Force sites (27 hospitals and 31 clinics). The Air Force Surgeon General documented an immediate critical need for automated patient appointing and scheduling support and Defense had available government owned software which was capable of supporting this requirement. The software, however, represents only one of nine functional areas of the total system. Subsequent legislation (Fiscal Year 1991 National Defense Authorization Act) limiting System deployment, was implemented promptly. The legislation resulted in reexamination of two delivery orders for site deployment, which were canceled. Thus, depending upon the outcome of the Patient Appointing and Scheduling certification, only the Patient Appointing and Scheduling module of the Composite Health Care System would be activated at the 27 hospitals with the Standard Appointment and Scheduling System and at the Patient Appointing and Scheduling certification site. The full System is being activated at the 12 test sites. No further deployment will occur prior to completion of operational test and evaluation. The Department of Defense intends to remain fully compliant with its guidance and legislation.

Expenditures to date to deploy the Composite Health Care System need to be clarified. The GAO stated that as of April, 1991, deployment to Air Force sites was completed at a cost of about $5.4 million. In fact, the deployment of the Standard Appointing and Scheduling System was completed in April 1991, at a cost of $3.8 million. The GAO also stated that Defense had expended or issued purchase orders at another 18 military hospitals for a total of $7.8 million. The Department issued purchase orders for

a total of $1.7 million to conduct site surveys at 18 sites. Additionally, $3.2 million has been expended to install, operate and maintain the Patient Appointing and Scheduling module at the Malcolm Grow Medical Center at Andrews Air Force Base for certification testing in compliance with congressional direction.

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RECOMMENDATIONS TO THE DEPARTMENT OF DEFENSE

RECOMMENDATION 1: The GAO recommended that the Secretary of Defense direct the Assistant Secretary of Defense for Health Affairs and the Military Departments to refrain from deploying the Composite Health Care System without the capability to archive and retrieve patient data. (p. 12/ GAO Draft Report)

See comment 7.

DoD Response: Nonconcur. It is premature to make a decision regarding the deployment of the archive/retrieve capability until all data are presented to the Major Automated Information System Review Council. At the first Milestone III review, based on information on costs, benefits, performance, risks, and an early operational assessment, the Review Council will decide whether the Composite Health Care System increments should be deployed prior to the inclusion of the archive and retrieve capability.

RECOMMENDATION 2: The GAO recommended that the Secretary of Defense direct the Assistant Secretary of Defense for Health Affairs and the Military Departments to refrain from further deployment of the system until completion of operational testing and evaluation and the performance of a cost/benefit analysis that justified such a deployment. (p. 12/ GAO Draft Report)

DoD Response: Concur. The deployment of the Composite Health Care System following completion of operational test and evaluation and a cost/benefit analysis is consistent with the policy of the Major Automated Information System Review Council that functional capabilities of any program be tested and evaluated adequately prior to deployment and the Composite Health Care System is no exception. A full operational test and evaluation will be conducted prior to deployment of each increment. An updated cost/benefits analysis will be validated prior to incremental deployment decision reviews by the Council. The deployment decisions will also consider future increments, the capabilities being provided, the deployment schedules, and risks associated with those increments.

The following are GAO's comments on the Department of Defense's letter dated August 22, 1991.

GAO Comments

1. Defense partially concurs with our findings related to the costs and benefits of CHCS. We agree with Defense that the cost and benefit analysis is a continuous process. We further support the effort Defense is making to validate and continuously update its estimates. We have also revised the report to clarify the reason that the CHCS cost ceiling was changed.

2. We are pleased that Defense believes archiving and retrieving of patient records is essential to the system's operation. However, the balance of the comment contains both factual errors and a mistaken conclusion.

We do not agree with Defense's comment that the development of the archive and retrieve capability has been completed. According to a contractor progress report dated August 26, 1991, archiving is still under development. In fact, identification of the files and fields to be archived is not expected to be finalized until the September 1991 reporting period, and operational testing of a fully integrated archiving system is not scheduled until after the milestone III deployment decision. The plan not to field-test the archiving capability prior to a full deployment decision is not consistent with technology testing standards or Defense regulations. Laboratory testing is not a substitute for real-life operational tests. A MAISRC deployment decision on a $1.6 billion patient medical information system should not be based on a contractor laboratory test.

The contention by Defense that deploying CHCS without the archive and retrieve function is low risk because it will be some 18-24 months before this capability is needed, ignores the complexity of the function and the essentiality of archiving to both successful medical operations and cost containment. There is no guarantee that the archiving function will be operational in 18-24 months. Complex software is often delivered late and often performs badly. We continue to believe that because this capability is so essential and the implementation of an effective solution is so complex, it should be tested in an environment that is operationally realistic and representative of the sites, as outlined in Defense policy. Following this path will reduce risk and increase the probability that Defense will field a system that is operationally effective and suitable for the mission for which it is intended.

3. The completion of a streamlined method for physicians' entry of orders is critical to physicians' acceptance of CHCS as well as a significant purported dollar amount of benefits. We did not intend to make an overall comparison in our report of the time it took for a physician to write an order with the overall advantages of entering that order in CHCS. Our purpose was to focus on the need to gain physician acceptance by improving the ease with which physicians can enter their orders. We have revised our report to clarify this and reflect the improvements that have been made in the entry of physician orders.

The system, however, is still unacceptable to physicians. This is primarily because it is tedious and cumbersome for physicians to enter conditional and complex orders. The entry of these types of orders can require a physician to enter data through the keyboard to bring up as many as 10 different screens. Some improvements have been made in the way physicians enter these orders, but the system is still not "user friendly" to physicians.

This lack of acceptance by physicians was evident when the functionality was deployed to the test sites in the spring of 1990. As of August 1991, only 5 of the 12 test sites had chosen to activate the order-entry functionality. Defense's current schedule does not yet contain a date for deploying the physician's one-line-order-entry.

4. In our report we have emphasized the importance of one-line-order-entry to CHCS being able to accomplish its mission, obtain wide-based physician acceptance, and then demonstrate that the system is cost beneficial. We continue to believe that the risks involved in deploying CHCS without this capability need to be carefully evaluated and the costs and benefits carefully analyzed.

The wisdom of whether to field CHCS without one-line-order-entry is separate from the question of how Defense can best provide for medical treatment facilities with "desperate needs" or "aging automated systems that require immediate replacement." The Congress, in the Fiscal Year 1991 National Defense Authorization Act established a process for Defense to make deployments to meet these needs. This process requires Defense to certify that, among other things, the CHCS software version to be deployed is the most cost-effective method of meeting the need, is successfully tested, and does not adversely effect the contractor's ability to complete ongoing OT&E. Defense can make these deployments if it can certify them in accordance with congressional direction.

5. Defense claims that its early deployments of CHCS did not violate its directives and legislation. We do not agree. The appropriations act and Defense instructions clearly require the completion of a milestone review and approval before the obligation of funds to acquire a system such as CHCS.

With regard to the appropriations act prohibition on fund obligation for major information systems that have not successfully completed oversight reviews "required by Defense Department Regulations," Defense asserts that the milestone reviews required by DOD Instruction 7920.2 only represent the "minimum" set of review points for management oversight. Defense argues that nothing in the statutory prohibition on obligations limits oversight reviews to milestone reviews, and that management reviews like the MAISRC in-process review held on May 21, 1991, meet the statutory language for fund obligation.

We do not agree with Defense's position. We accept both the fact that milestone reviews are "minimums" and that management can involve itself with reviewing programs at times other than the milestones. Milestone reviews, however, are the only reviews required by Defense. While the Instruction authorizes in-process reviews, it does not require them. Their occurrence is left to MAISRC's discretion and is a MAISRC requirement only. Moreover, even the June 1988 advice of the Office of the Secretary of Defense specified that existing legislation requires that not only does a system have to successfully complete "an appropriate management review" before funds are obligated, but the required "milestone approval" has to be obtained. Defense's comments seem to be inconsistent with that advice.

Defense responded that deployments to date are consistent with Review Committee authorizations and existing legislation because Defense regulations specifically provide for conditional approvals. We do not agree with this position. A conditional approval does not necessarily equate to successfully completing the statutorily required oversight review because the condition must still be met for the milestone requirement to be satisfied. Because these deployments to the Air Force sites and additional 19 military facilities were made prior to the appropriate milestone decision, we continue to believe they were in violation of Defense directives and legislation.

6. Defense states that CHCS was deployed to Malcolm Grow Medical Center for certification of the Patient Appointment and Scheduling module in compliance with congressional direction. This statement is

inaccurate because deployment to Malcolm Grow was initiated prior to the congressional direction on site certification. The deployment to Malcolm Grow was initiated with a delivery order dated May 14, 1990, totalling over $70,565 to conduct a site survey. The requirement to certify deployment of CHCS to additional medical treatment facilities was not established by the Congress until November 5, 1990. At that time, Defense had already issued delivery orders for over $2.5 million to install CHCS at the center and was preparing to activate a minimum of four CHCS modules—Pharmacy, Patient Appointment and Scheduling, Radiology, and Laboratory.

Defense states that deployment of a CHCS appointment and scheduling system was based on a sound business decision. However, CHCS program officials have not provided us with documentation showing the basis of this decision and have informed us that they were not aware of any cost-benefit analysis justifying this deployment.

The cost information presented in our report regarding the premature deployment of CHCS beyond established test sites was based on information provided by Defense. The $5.4 million for deployment to Air Force sites is based on Air Force documentation. This documentation shows the cost of deploying CHCS to 58 sites to be $3.8 million in Other Procurement funds, the amount cited in the Defense comments, and $1.6 million in Operation & Maintenance funds.

The $7.8 million cited in our report has been adjusted to $7.5 million as a result of a reexamination of Defense contract delivery orders. The information was obtained from the CHCS Contracting Officer and indicates that $2.0 million worth of orders were issued for conducting site surveys (including the site survey at Malcolm Grow Medical Center) and $5.5 million to install, operate, and maintain CHCS-related hardware and software at facilities that are not test sites (the latter figure includes $3.2 million to install, operate and maintain the Patient Appointment and Scheduling module at Malcolm Grow Medical Center).

7. We agree with Defense that the archive and retrieval capability should not be deployed until all relevant data are presented to MAISRC. We continue to believe, however, that as stated in the Agency Comments section of our report and as detailed in Comment 2 of this appendix, that this capability is essential to the effective and suitable operation of any increment of CHCS. Therefore, it must be operationally tested at the test sites before the first milestone III deployment of CHCS is made.

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Related GAO Products

Medical ADP Systems: Composite Health Care System: Defense Faces a Difficult Task (GAO/IMTEC-90-42, Mar. 15, 1990).

Medical ADP Systems: Composite Health Care System Operational Tests Extended (GAO/IMTEC-89-30, Apr. 10, 1989).

Medical ADP Systems: Analysis of Technical Aspects of DOD's Composite Health Care System (GAO/IMTEC-88-27, Jul. 11, 1988).

Medical ADP Systems: Composite Health Care System Acquisition—Fair, Reasonable, and Supported (GAO/IMTEC-88-26, Mar. 4, 1988).

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